

month, except the 28th and 29th. In Louisiana there were one or more thunderstorms on each day of the month. In Arkansas, thunderstorms were reported on every day except the 24th. In Colorado there were thunderstorms continuously from the 3d to the 23d, inclusive. On the Pacific coast reports of 99 thunderstorms were received, distributed as follows: 33 in Washington, 39 in Oregon, and 27 in California.

**Auroras.**—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz, from May 30 to June 7.

The greatest number of reports were received for the following dates: 22d, 6; 14th, 25th, and 29th, 4 each.

Reports were most numerous from Ohio, 6; Minnesota, North Dakota, and Wisconsin, 4 each.

## CLIMATE AND CROP SERVICE.

By JAMES BERRY, Chief of Climate and Crop Service Division.

The following extracts relating to the general weather conditions in the several States and Territories are taken from the monthly reports of the respective sections of the Climate and Crop Service. The name of the section director is given after each summary.

Rainfall is expressed in inches.

**Alabama.**—The mean temperature was 80.4°, or 2.8° above normal, the highest was 103°, at Decatur on the 10th, and the lowest, 55°, at Madison on the 1st. The average precipitation was 3.60, or 0.87 below normal; the greatest monthly amount, 7.99, occurred at Evergreen, and the least, 0.90, at Riverton.—*F. P. Chaffee.*

**Arizona.**—The mean temperature was 79.6°; the highest was 119°, at Parker on the 26th and the lowest, 20°, at Snowflake on the 11th. The average precipitation was 0.60; the greatest monthly amount, 2.60, occurred at Fort Apache and Oro, while none fell at Agricultural Experiment Station at Phenix, and only trace at several stations.—*W. T. Blythe.*

**Arkansas.**—The mean temperature was 78.7°, or 2.3° above normal, the highest was 100°, at Lonoke on the 25th, and the lowest, 60°, at several stations on different dates. The average precipitation was 4.86, or 0.80 above normal; the greatest monthly amount, 11.15, occurred at Ozark, and the least, 1.85, at Stuttgart.—*E. B. Richards.*

**California.**—The mean temperature was 71.3°, or 0.1° below normal; the highest was 123°, at Volcano Springs on the 26th, and the lowest, 17°, at Bodie on the 4th. The average precipitation was 0.25, or 0.01 below normal; the greatest monthly amount, 3.32, occurred at Upper Mattole. No rain fell over the greater portion of the State.—*W. H. Hammon.*

**Colorado.**—The mean temperature was 62.6°, or about normal; the highest was 108°, at Crook on the 28th, and the lowest, 17°, at Walden on the 4th, and at Breckenridge on the 5th. The average precipitation was 1.73, or 0.50 above normal; the greatest monthly amount, 3.95, occurred at Cheyenne Wells, and the least, trace, at Rangely.—*F. H. Brandenburg.*

**Florida.**—The mean temperature was 80.9°, or 1.9° above normal; the highest was 101°, at Eustis on the 12th, and at Lake City on the 16th, and the lowest, 54°, at St. Francis on the 8th and 9th. The average precipitation was 3.08, or 3.92 below normal, it was the driest June on record; the greatest monthly amount, 9.07, occurred at Earnestville, and the least, trace, at Carrabelle.—*A. J. Mitchell.*

**Georgia.**—The mean temperature was 80.1°, or 2.2° above normal; the highest was 103°, at Brag on the 30th, and the lowest, 50°, at Ramsey on the 23d. The average precipitation was 3.27, or 1.43 below normal; the greatest monthly amount, 6.94, occurred at Fleming, and the least, 0.89, at Atlanta and Toccoa.—*J. B. Marbury.*

**Idaho.**—The mean temperature was 60.8°; the highest was 102°, at Nampa on the 18th, and the lowest, 23°, at Marysville on the 2d. The average precipitation was 1.07; the greatest monthly amount, 2.10, occurred at Yellowjacket, and the least, 0.15, at Marysville.—*D. P. McCallum.*

**Illinois.**—The mean temperature was 73.3°, or about 1.0° above normal; the highest was 97°, at Bloomington on the 4th and 6th, and the lowest, 41°, at Kishwaukee on the 22d. The average precipitation was 4.34, or 0.35 above normal; the greatest monthly amount, 9.88, occurred at Cambridge, and the least, 1.10, at Olney.—*C. E. Linney.*

**Indiana.**—The mean temperature was 73.2°, or 1.1° above normal; the highest was 99°, at Winamac on the 4th, and the lowest, 39°, at Auburn on the 1st. The average precipitation was 3.81, or 0.23 below normal; the greatest monthly amount, 7.80, occurred at Princeton, and the least, 1.18, at Topeka.—*C. F. R. Wapenhans.*

**Iowa.**—The mean temperature was 71.4°, or about 1.0° above normal; the highest was 99°, at Belle Plaine on the 30th, and the lowest, 42°, at Forest City on the 27th. The average precipitation was 4.72, or slightly above normal; the greatest monthly amount, 12.48, occurred at Greenfield, and the least, 1.90, at Olin.—*G. M. Chappell.*

**Kansas.**—The mean temperature was 74.9°, or 0.9° above normal;

the highest was 108°, at Dresden on the 25th, and the lowest, 40°, at Colby on the 1st. The average precipitation was 4.60, or 0.54 above normal; the greatest monthly amount, 9.96, occurred at Fort Scott, and the least, 1.43, at Wallace.—*T. B. Jennings.*

**Kentucky.**—The mean temperature was 76.2°, or 1.4° above normal; the highest was 101°, at Shelbyville on the 10th, and the lowest, 45°, at Maysville on the 22d. The average precipitation was 3.90, or about normal; the greatest monthly amount, 7.94, occurred at Lexington, and the least, 1.55, at Williamsburg.—*G. E. Hunt.*

**Louisiana.**—The mean temperature was 80.1°, or about 1.0° above normal; the highest was 100°, at Plaquemine on the 1st, and the lowest 60°, at Napoleonville on the 3d, 5th, and 11th, and at Opelousas on the 5th. The average precipitation was 7.64, or about 1.75 above normal; the greatest monthly amount, 14.56, occurred at Plain Dealing, and the least, 1.07, at Port Eads.—*R. E. Kerkam.*

**Maryland and Delaware.**—The mean temperature was 71.7°, or 0.6° above normal; the highest was 100°, at Bachmans Valley, Md., on the 25th, and at Westernport, Md., on the 30th, and the lowest, 35°, at Deepark, Md., on the 24th. The average precipitation was 2.00, or 1.17 below normal; the greatest monthly amount, 3.99, occurred at Newark, Del., and the least, 0.35, at Maryland Agricultural College.—*F. J. Walz.*

**Michigan.**—The mean temperature was 65.7°, or 0.4° above normal; the highest was 96°, at Allegan on the 5th, at Ionia on the 24th, and at Rogers on the 25th; the lowest was 27°, at Iron River on the 15th. The average precipitation was 3.61, or 0.41 above normal; the greatest monthly amount, 7.29, occurred at West Harrisonville, and the least, 0.80, at Hart.—*C. F. Schneider.*

**Minnesota.**—The mean temperature was 67.0°, or about normal; the highest was 99°, at Beardsley on the 23d, and the lowest, 33°, at Mount Iron on the 15th. The average precipitation was 3.93, or about normal; the greatest monthly amount, 11.79, occurred at Pine River Dam, and the least, 1.94, at St. Olaf.—*T. S. Outram.*

**Mississippi.**—The mean temperature was 80.2°, or 1.1° above normal; the highest was 102°, at Aberdeen on the 25th and at Columbus on the 3d, and the lowest, 60°, at Corinth on the 1st, at Leakesville on the 2d, and at Waynesboro on the 16th. The average precipitation was 4.99, or 0.74 above normal; the greatest monthly amount, 10.75, occurred at Fayette, and the least, 1.19, at Booneville.—*R. J. Hyatt.*

**Missouri.**—The mean temperature was 75.3°, or 1.9° above normal; the highest was 100°, at Jefferson City on the 30th, and the lowest, 42°, at Potosi on the 20th. The average precipitation was 5.89, or 1.15 above normal; the greatest monthly amount, 11.08, occurred at Arthur, and the least, 2.42, at Downing.—*A. E. Hackell.*

**Montana.**—The mean temperature was 58.9°, or slightly below normal; the highest was 103°, at Glendive on the 19th, and the lowest, 28°, at Adel on the 1st. The average precipitation was 3.34, or about 0.50 above normal; the greatest monthly amount, 6.79, occurred at Wibaux, and the least, 1.08, at Columbia Falls.—*J. Warren Smith.*

**Nebraska.**—The mean temperature was 70.4°, or about 1.0° above normal; the highest was 109°, at Franklin on the 24th, and the lowest, 33°, at Camp Clarke on the 5th. The average precipitation was 3.54, or about 0.40 below normal; the greatest monthly amount, 11.62, occurred at Geneva, and the least, trace, at Lodgepole.—*G. A. Loveland.*

**Nevada.**—The mean temperature was 65.0°, or 0.7° below normal; the highest was 104°, at Panaca on the 27th, and the lowest, 20°, at Monitor Mill on the 2d. The average precipitation was 0.19, or about half the normal amount; the greatest monthly amount, 2.38, occurred at Toano, while none fell at many stations.—*R. F. Young.*

**New England.**—The mean temperature was 64.5°, or 0.7° below normal; the highest was 93°, at Middletown, Conn., on the 25th and 26th, and at Waterbury, Conn., on the 26th, and the lowest, 31°, at Flagstaff, Me., on the 11th. The average precipitation was 2.69, or 0.20 below normal; the greatest monthly amount, 7.36, occurred at Pittsfield, Mass., and the least, 0.10, at Narragansett Pier, R. I.—*J. W. Smith.*

**New Jersey.**—The mean temperature was 70.1°, or 0.5° above normal; the highest was 100°, at Vineland on the 28th, and the lowest, 38°, at Charlotteburg on the 16th and 23d. The average precipitation was

2.10, or 1.55 below normal; the greatest monthly amount, 3.54, occurred at Billingsport Lighthouse, and the least, 1.13, at the College Farm, New Brunswick.—*E. W. McGann.*

*New Mexico.*—The mean temperature was 69.2°, or about 4.0° below normal; the highest was 106°, at Albert on the 25th, and the lowest, 23°, at Buckmans on the 3d. The average precipitation was 2.12, or 0.25 below normal; the greatest monthly amount, 6.05, occurred at Roswell, and least, trace, at Deming.—*R. M. Hardinge.*

*New York.*—The mean temperature was 66.9°, or 1.3° above normal; the highest was 96°, at Poughkeepsie on the 15th, and the lowest, 32°, at Alfred, Bolivar, and South Canisteo on the 16th. The average precipitation was 2.74, or 0.76 below normal; the greatest monthly amount, 6.87, occurred at Humphrey, and the least, 0.62, at Setauket.—*R. G. Allen.*

*North Carolina.*—The mean temperature was 74.8°, or about 0.5° above normal; the highest was 104°, at Goldsboro on the 10th, and the lowest, 40°, at Linville on the 23d. The average precipitation was 3.41, or about 1.00 below normal; the greatest monthly amount, 7.32, occurred at Sloan, and the least, 0.70, at Springhope.—*C. F. von Herrmann.*

*North Dakota.*—The mean temperature was 62.5°, or 2.1° below normal; the highest was 105°, at Medora on the 18th, and the lowest, 26°, at Woodbridge on the 14th. The average precipitation was 2.69, or 1.15 below normal; the greatest monthly amount, 6.80, occurred at University, and the least, 0.68, at Ashley.—*B. H. Bronson.*

*Ohio.*—The mean temperature was 71.9°, or 1.5° above normal; the highest was 99°, at Seaman on the 7th, and the lowest, 39°, at Montpelier on the 3d, at Rittman on the 22d, and at Greenhill on the 23d. The average precipitation was 2.86, or 0.90 below normal; the greatest monthly amount, 7.05, occurred at Millport, and the least, 0.83, at New Bremen.—*H. W. Richardson.*

*Oklahoma.*—The mean temperature was 77.4°; the highest was 102°, at Jefferson and Newkirk on the 25th, and at Kemp on the 22d, and the lowest, 52°, at Waukomis on the 2d. The average precipitation was 4.64; the greatest monthly amount, 8.58, occurred at Pawhuska, and the least, 1.66, at Guthrie.—*J. I. Widmeyer.*

*Oregon.*—The mean temperature was 62.2°, or 1.7° above normal; the highest was 99°, at Pendleton on the 10th, and at Riverside on the 18th, and the lowest, 23°, at Prineville on the 27th. The average precipitation was 1.72, or 0.16 above normal; the greatest monthly amount, 9.75, occurred at Toledo, and the least, 0.24, at Lakeview.—*B. S. Pague.*

*Pennsylvania.*—The mean temperature was 69.6°, or slightly above normal; the highest was 100°, at Aqueduct on the 25th, and the lowest, 33°, at Shinglehouse on the 16th. The average precipitation was 2.79, or 1.31 below normal; the greatest monthly amount, 6.96, occurred at Elwood Junction, and the least, 0.56, at Reading.—*T. F. Townsend.*

*South Carolina.*—The mean temperature was 79.7°, or 2.2° above normal; the highest was 105°, at Gillisonville on the 29th, and the lowest, 55°, at Trenton on the 6th, and at Santuck on the 7th. The average precipitation was 4.15, or 0.47 below normal; the greatest monthly amount, 10.68, occurred at Pinopolis, and the least, 1.58, at Central.—*J. W. Bauer.*

*South Dakota.*—The mean temperature was 67.3°, or about normal; the highest was 113°, at Cherry Creek on the 22d, and the lowest, 30°, at

at Rochford on the 27th. The average precipitation was 2.16, or 1.62 below normal; the greatest monthly amount, 5.68, occurred at Canton, and the least, trace, at Interior.—*S. W. Glenn.*

*Tennessee.*—The mean temperature was 76.7°, or slightly above normal; the highest was 102°, at Elizabethton on the 10th, and the lowest, 44°, at Silverlake on the 23d. The average precipitation was 3.70, or considerably below normal; the greatest monthly amount, 7.02, occurred at Peryear, and the least, 1.41, at Andersonville.—*H. C. Bate.*

*Texas.*—The mean temperature for the State during the month, determined by comparison of 39 stations distributed throughout the State, was normal. There was a slight deficiency over the coast district, over the panhandle, and west Texas, with the greatest, 4.5°, in the vicinity of El Paso, while over the other portions of the State, the temperature was generally above the normal, with the greatest excess, 5.2°, in the vicinity of Brownwood. The highest was 104°, at Fort McIntosh on the 2d, 3d, and 4th, and the lowest, 40°, at Valentine on the 7th. The average precipitation for the State during the month, determined by comparison of 39 stations distributed throughout the State, was 1.78 above the normal. There was a slight deficiency along the coast, over west Texas, and in a few other localities, with the greatest deficit, 2.93, at Galveston, while over other portions of the State there was a general excess, ranging from 0.97 to 3.81 over east and north Texas and the panhandle, and from 1.02 to 5.99 over central and southwest Texas, with the greatest, 5.99, at Coleman; the greatest monthly amount, 10.85, occurred at Ballinger, and the least, 0.08, at Point Isabel.—*I. M. Cline.*

*Utah.*—The mean temperature was 65.2°; the highest was 110°, at Mount Pleasant on the 18th, and the lowest, 22°, at Soldier Summit on the 3d. The average precipitation was 0.78, or slightly above normal; the greatest monthly amount, 1.58, occurred at Tooele, and the least, 0.11, at Frisco.—*J. H. Smith.*

*Virginia.*—The mean temperature was 73.2°, or nearly normal; the highest was 104°, at Doswell on the 30th, and the lowest, 40°, at Burkes Garden on the 22d. The average precipitation was 2.85, or 0.83 below normal; the greatest monthly amount, 4.86, occurred at Bigstone Gap, and the least, 0.45, at Alexandria.—*E. A. Evans.*

*Washington.*—The mean temperature was 60.6°, or about 1.5° above normal; the highest was 103°, at Kennewick on the 10th, and the lowest, 28°, at Hunters on the 28th. The average precipitation was 2.38, or about 0.50 above normal; the greatest monthly amount, 8.56, occurred at Clearwater, and the least, 0.29, at Moxee.—*G. N. Salisbury.*

*West Virginia.*—The mean temperature was 70.9°; the highest was 99°, at Martinsburg on the 26th, and the lowest, 41°, at Dayton and Nuttallburg on the 22d. The average precipitation was 3.20, or about 1.00 below normal; the greatest monthly amount, 7.50, occurred at Marlinton, and the least, 0.66, at Burlington.—*C. M. Strong.*

*Wisconsin.*—The mean temperature was 66.7°, or about normal; the highest was 96°, at Heafford Junction on the 4th, and the lowest, 31°, at Florence on the 15th. The average precipitation was 3.88, or slightly below normal; the greatest monthly amount, 9.70, occurred at Beloit, and the least, 1.50, at Eau Claire.—*W. M. Wilson.*

*Wyoming.*—The mean temperature was 60.0°, or 0.2° below normal; the highest was 99°, at Fort Laramie on the 28th, and the lowest, 28°, at Four Bear on the 29th. The average precipitation was 1.68, or about normal; the greatest monthly amount, 3.02, occurred at Lander, and the least, 0.55, at Bigpiny.—*W. S. Panner.*

## SPECIAL CONTRIBUTIONS.

### A NEW METHOD OF OBSERVING THE DIRECTION OF MOVEMENT OF THE ATMOSPHERE.

By Mr. H. W. CLOUGH.

Under date of October 13, 1897, Mr. H. W. Clough, observer, Weather Bureau, who was then at Nashville, sent the Editor a communication from which the following interesting extract is made:

For a number of years I have been cognizant of a fact which may have an important meteorological bearing, and seems to throw light upon that mooted point in astronomy, the scintillation of the stars.

Several years ago I discovered that on holding a simple convex lens of, for example, 30 inches focus and 3 inches diameter, between the eye and a distant point of light, as an electric light at night, the lens being held at a distance of slightly less than the focal length from the eye, so that the light entirely fills the lens, there are seen horizontal undulations or streams, or rather, irregular masses of light and darkness moving swiftly across the field of view. These wave like masses vary in speed and definiteness of appearance with the position and distance of the source of light, and it was soon discovered that the direction of the undulations corresponded with the direction of the surface wind, and that it was easy to ascertain the latter within a few degrees by this means, as on pointing the lens in the direction of the wind no lateral movement of the undulations is observed, but simply a turbu-

lent motion with no particular direction. This phenomenon is probably due to air currents of varying temperature passing between the light and lens, causing variations in the light coming to the eye. I have noticed a similar phenomenon during hot windy days in summer when the "boiling" at the horizon is most pronounced. By directing a telescope at various objects in different azimuths the direction of movement of the undulations or waves of the unequally heated strata of air is seen to coincide with the direction of the wind.

As to the scintillation of stars, I have no doubt that it is in all respects similar to the undulations observed with the lens in distant points of light. In fact the electric lights in a city exhibit scintillations, the more distant ones showing them with great distinctness. These are magnified by the lens and shown to be due to air currents of different temperature causing irregular refractions of the light. The more distant the light, the slower is the apparent movement of the undulations. I have many times observed with the lens bright stars near the horizon and endeavored to ascertain the direction of movement of the undulations which are plainly visible, but the lens used was not of sufficient size to allow the direction to be made out. Probably a lens of at least 5 inches in diameter and 3 feet focus would collect enough light and present a sufficiently large surface to show the direction of the undulations. It would seem that this may have an important application in meteorology as indicating a possible method of ascertaining the direction of air currents at night; not only those near the surface, but possibly those of considerable altitude.